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OBSERVATIONS ON THE OVIPOSITION BEHAVIOUR IN *APOCRYPTA BAKERI* JOSEPH (TORYMIDAE: HYMENOPTERA)[1]

U. C. Abdurahiman and K. J. Joseph[2]
(*With two text-figures*)

Apocrypta bakeri Joseph is a cleptoparasite of the agaonid, *Ceratosolen marchali* Mayr, breeding in the receptacles of *Ficus hispida* L. Observations on the process of oviposition and the related behaviour of these torymid wasps are briefly given and discussed. The presence of the abdominal keel, formed of the telescopically arranged basal segments is a unique feature and facilitates the penetration of the ovipositor across the fig wall. The eggs are deposited only in those ovaries of *Ficus* where the agaonid, *C. marchali* has deposited its egg and injected the secretion from its poison glands. The presence of these 'internal host factors' possibly detected by the sensillae present at the tip of the ovipositor of *A. bakeri* inform this insect about the suitability or otherwise of the fig ovary for oviposition and serve as factors determining successful oviposition.

Introduction

The oviposition behaviour in different genera of fig-inhabiting torymids has been very little investigated. Joseph (1953) observed the process of egg-laying in *Sycoscapteridea* (=*Neosycoecus*) *indica* Joseph. He gave a detailed account of the process of oviposition and the factors determining the same in *Philotrypesis caricae* L., cleptoparasite of *Blastophaga psenes* L. developing in the syconia of *Ficus carica* L. (Joseph 1958 & 1959). Ansari (1966) studied the process of oviposition in *Parakoebelea stratheni* (=*glomeratus*) Joseph. The present paper embodies the results of our study of the oviposition behaviour in *Apocrypta bakeri* Joseph, which develops as a cleptoparasite of the agaonid, *Ceratosolen marchali* Mayr, breeding in the receptacles of *Ficus hispida* L. It is for the first time that the oviposition behaviour of a species of the genus *Apocrypta* is studied.

[1] Accepted July 1977.
[2] Department of Zoology, University of Calicut, Kerala 673635.

Material and Methods

Mature gall figs of *Ficus hispida* were brought to the laboratory. The females of *Apocrypta bakeri* eclosed were reared in the laboratory, feeding them with diluted honey. Tender figs of appropriate stage, freshly collected from the tree were provided to these females for oviposition.

Ovipositing females were observed under the Stereomicroscope for studying the various stages of oviposition and related behavioural aspects. The path taken by the ovipositor inside the fig was traced by cutting the ovipositor at its basal part at the time of oviposition and then by following its course by dissection of the fig wall.

Field observations on the oviposition behaviour in *A. bakeri* were also made to supplement our study in the laboratory.

Observations and Results

In nature, oviposition is more frequent in the morning hours, normally between 6 A.M. and 10 A.M. As many as eight females were observed in the act of oviposition on the same fig. The large scale eclosion of the females in the early morning is one of the probable reasons why a large number of females were observed ovipositing during the morning hours. Under laboratory conditions, the females readily showed oviposition behaviour during the day when suitable tender figs were provided.

The oviposition behaviour in *A. bakeri* can be conveniently divided for our study purpose into 3 different stages.

a) *Selection of a suitable area for insertion of the ovipositor*:

The females on eclosion remain for a while on the fig surface. No distinct pre-oviposition period was observed, and many females accomplished oviposition soon after their eclosion. On the surface of the tender figs, the insect wanders in search of a suitable spot to insert the ovipositor. This search is aided by the antennae, the tips of which are kept in contact with the fig surface as the insect moves along (Fig. 1a). It would seem therefore, that certain olfactory cues perceived by the antennae initially inform the insect about the suitability or otherwise, of the spot to be selected for insertion of the ovipositor. The insect now raises the abdomen to the maximum height possible by straightening the hind legs. Along with this the abdomen is elevated from its normal position. Simultaneously, the seven basal abdominal segments that constitute the ventral abdominal keel are stretched and this part of the abdomen now further brought perpendicular to the thorax (Fig. 1b). The remaining segments of the abdomen along with the terminal ovipositor are now folded down and the tip of the ovipositor is brought in contact with the selected spot, aided by the hind legs (Fig. 1c). Now the insect undertakes a detailed examination of the spot where its ovipositor has touched the fig surface. This seems to be done by means of the sensory setae present at the tip of the ovipositor and its sheaths. On several occasions the insect was found to abandon the initially chosen site and recommence its search for another suitable site.

b) *Penetration of the ovipositor and deposition of the eggs*:

When the suitable spot is finally selected the hind legs are slowly bent downwards and the hypopygium is lowered in stages as the ovipositor pierces and penetrates into the wall of the fig (Figs. 1d & 1e). The penetration of the ovipositor down the fig wall is also aided by the force exerted by waves of contraction of the abdomen starting at its base and travelling rhythmically towards its tip. With the further

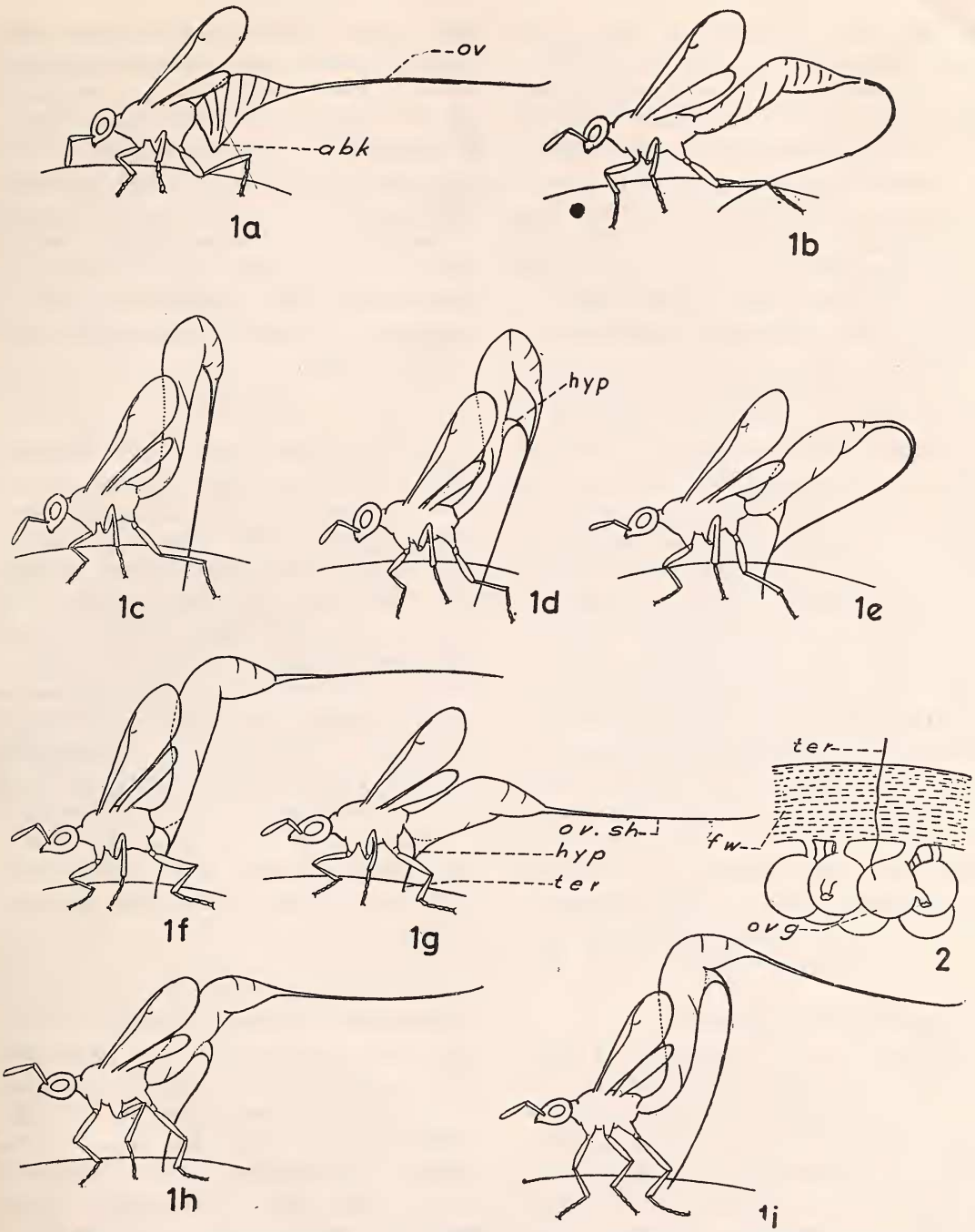

Fig. 1a-1i. Different stages of oviposition. (1a-1c: Selection of a suitable spot for oviposition on the syconium; 1d-1e: Penetration of the ovipositor across the fig wall; 1f-1g: egg laying; 1h-1i; withdrawal of the ovipositor). Fig. 2. Section of a part of the fig showing the path taken by the ovipositor into a *Ficus* ovary.

Abbreviations: abk—abdominal keel; fw—Fig wall; hyp—hypopygium; ov—ovipositor; ov. sh—ovipositor sheaths; ov. g—ovarian gall; ter—terebra (penetrating stylets of the ovipositor).

penetration of the ovipositor its valves which till now helped to fix and direct the ovipositor proper are detached and now they regain their normal resting position horizontal to the body (Fig. 1f). The hypophygium is now considerably lowered and in this position the ovipositor penetrates fully into the fig ovary (Fig. 1g). The egg is deposited in this stage. At times the ovipositor is seen to be slightly pulled out and inserted again, this act being repeated until it has penetrated into the selected gall flower.

The course taken by the ovipositor could be easily traced by cutting the ovipositor in the ovipositing stage and tracing it *in situ* into the gall flower by appropriate dissection (Fig. 2). The egg comes to be deposited in the nucellus of the *Ficus* ovary, normally away from the region of the style, with the small stalk of the egg attached to the ovarian wall.

c) *Withdrawal of the ovipositor*:

After the process of oviposition, the legs are slowly stretched, the hypophygium is raised little by little, and the abdomen is elevated and brought to a perpendicular position with respect to the thorax (Figs. 1h & 1i) resulting in the complete withdrawal of the ovipositor, which is then cleaned with the help of the tibial spurs of the hind legs. The ovipositor is now ensheathed inside its valves and brought to its normal position of rest. The whole process of oviposition is completed within eight to ten minutes.

Factors determining Oviposition:

The internal factors determining egg deposition in *A. bakeri* include the presence of the egg of the host agaonid, *Ceratosolen marchali*, thereby assuring the presence of the secretion of the poison glands of this host insect in the same ovary. When tender figs free of *Ceratosolen* eggs were provided to the females of *A. bakeri*, no eggs were laid eventhough the earlier stages of oviposition behaviour were observed. In some cases, when such figs were examined, the fig ovary did not contain the eggs of *A. bakeri*. This observation supports the possibility of *Apocrypta* laying its eggs only in those gall flowers in which *Ceratosolen* female has already laid its egg and injected the secretion of its poison glands. The presence of this secretion may be detected by means of the sensillae present at the tips of the ovipositor valves and of the stylets of the ovipositor proper.

Discussion

In all the torymid species where oviposition behaviour has been studied, the eggs are laid in the fig ovaries by introducing the ovipositor through the wall of the fig. However, closer analysis of the steps involved in oviposition reveals some important differences. In *Philotrypesis caricae*, the ovipositor is bent with a sharp angle between the elongated segments (8th and 9th) of the abdomen so that the ovipositor can be kept vertical to the fig surface (Joseph 1958). Abdurahiman (1972) observed a similar pattern of oviposition in *Philotrypesis pilosa*, which breeds in the receptacles of *Ficus hispida*. In *Parakoebelea stratheni* (Ansari 1966) and *Sycoscapteridea indica* (Joseph 1953) their abdominal structure does not probably allow such a sharp bending. In *Apocrypta bakeri*, the adaptations for oviposition are entirely different. The well developed abdominal keel (formed by the telescopic arrangement of the seven basal abdominal segments), can be stretched considerably to bring the abdominal tip and the ovipositor sufficiently high so that when the rest of the abdomen carrying the ovipositor is bent downwards, it will permit the ovipositor to penetrate the fig wall by the force of rhythmic contractions exerted upwards and downwards

along the "∩" shaped abdomen. This organisation is a unique feature of the genus *Apocrypta.*

In *Sycoscapteridea indica,* Joseph (1953) did not mention about the exact nature of ovaries of *Ficus infectoria* where the insect deposits its eggs. Ansari (1966) claimed that in *Parakoebelea stratheni,* the eggs are always laid in those ovaries of *Ficus glomerata* which did not contain any other eggs. In *Philotrypesis caricae,* Joseph (1958) showed conclusively that the egg-laying in a particular ovary of *Ficus carica* was dependent on the presence of the egg and more importantly of the secretion of the poison gland of *Blastophaga psenes* in the same ovary. It has been also suggested by the same author that the presence of the latter internal host factor is responsible for stimulating the sensory structures present at the extremity of the valves and stylets of the ovipositor, thus "informing" the torymid on the suitability for oviposition or otherwise of the particular fig ovary. The present studies also showed the role of these same factors (in this case brought about by *Ceratosolen marchali*) in determining the successful oviposition by *Apocrypta bakeri.*

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